"DIELECTRIC RELAXATION AND SPECTROSCOPIC STUDIES ON HALOALKANES"

Synopsis

Submitted to

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For the registration of the topic for
Doctor of Philosophy
In the faculty of
PHYSICS

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Abstract of proposed work plan/problem

"DIELECTRIC RELAXATION AND SPECTROSCOPIC STUDIES ON HALOALKANES"

1. Introduction

When an electromagnetic field is applied to a liquid, the atoms, molecules and free charges readjust their positions. The dynamic readjustment of the molecules in response to the field is called relaxation time. In other words orientation polarization decay exponentially with time; the characteristics time of this exponential decay is called relaxation time. The relaxation studies of liquids have been investigated extremely by means of various techniques such as Neutron Scattering, light scattering, Nuclear Magnetic Resonance (NMR), and broadband dielectric spectroscopy [1-4]. Dielectric relaxation spectroscopy has proven a powerful tool for an investigation of H-bond rearrangement dynamics and characterizations of organic liquids. The existence of permanent

dipoles and mobility of free charge contribute to dielectric response. At higher frequencies, the electric response of a material lags behind the applied field and creates loss.

Organic liquids like halogenoalkanes also known as haloalkanes or alkyl halides in which one or more hydrogen atoms in an alkane have been replaced by halogen atoms like Chlorine, Bromine, or Iodine. The substitution of hydrogen atom(s) in aliphatic or aromatic hydrocarbon by halogen atom(s) results in the formation of alkyl halide (haloalkane). A simple general formula that describes many of the haloalkanes usually included in basic chemistry:

$$C_nH_{2n+1}X$$

where, the letter ‘n’ represents the number of atoms in each molecule of the compound and the letter ‘X’ represents a particular halogen atom.

In the present research we will perform the temperature and frequency dependent study of Haloalkanes using Dielectric Relaxation and spectroscopic techniques.

2. Literature Review and Development in the Subject(previous work done in the relevant area):

Considerable experimental studies have been done on the dielectric relaxation behavior in polar systems to understand the molecular structure and dynamics of polar or non-polar molecules. Over the past few years, extensive experimental and theoretical studies concerning the microwave dielectric relaxation of halogenoalkanes and alcohol systems have been reported [5-14].

In the last few decades a large number of experimental studies have been attempted on dielectric relaxation of polar liquids using time domain reflectometry technique [13-16]. Time Domain Reflectometry (TDR) is used to describe a technique of observing time dependence reflection response of sample under study. H Fellner-Feldegg [17] first developed it for measurement of loss and permittivity at very high frequency range. Time domain reflectometry

technique is functional for the measurement of dielectric parameters of liquids covering wide frequency range with extremely accurate data in single measurement.

3. Objective research/Proposed Hypothesis:

The objective of the proposed is to study the dielectric relaxation and spectral characteristics of Haloalkanes solutions using Time Domain dielectric Relaxation technique having frequency range 10MHz to 50GHz at different temperatures to understand inter and intra molecular interactions in the liquid.

The aim of present study is to shed light on comparing the influence of the different polar groups in haloalkanes and their following dielectric relaxation parameters such as:

(I) The complex dielectric permittivity spectra

(II) Static dielectric constant

(III) Relaxation time

(IV) Thermodynamic parameters

(V) To study molecular interaction and hydrogen bonding

Therefore, present objective of the work is to study the Haloalkanes and determine the following parameters:

- To determine complex permittivity of Haloalkanes in aqueous and non-aqueous solvents using Time Domain Reflectometry Technique from 10 MHz to 50 GHz.
- To determine dielectric constant, dielectric loss and relaxation time at high frequency.
- To study molecular interaction and hydrogen bonding of solvents through various parameters.

4. Methodology to be adopted:

The complex dielectric spectra will be obtained by the Time Domain Reflectometry (TDR) technique. The Tektronix model no. DSA8300 Digital Serial Analyzer sampling mainframe along with the sampling module will be used for the Time Domain Reflectometry (TDR). Figure 1 shows experimental setup for TDR. A repetitive fast rising 250mV voltage pulse of 200 KHz with 12ps incident and 15ps reflected rise time was fed through coaxial line system of impedance 50 ohm. Sampling oscilloscope monitors changes in step pulse after

reflection from the end of line. Reflected pulse without sample $R_1(t)$ and with sample $R_x(t)$ will be recorded in time window of 5ns and digitized in 2000 points is shown in figure 1.

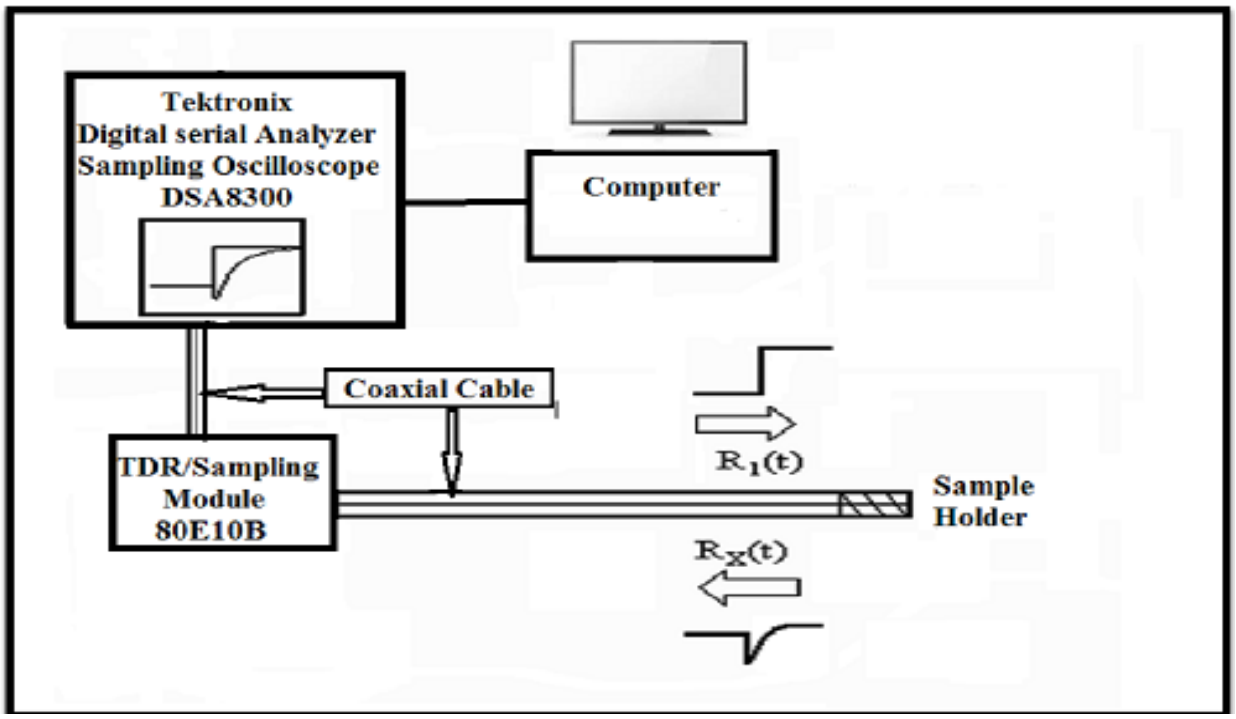

Fig1. Block diagram of a TDR

5. Importance of study/society application

During past few years, interest in liquid structure has grown rapidly, not only because of academic curiosity but also because of practical aspect that call for a fundamental understanding in terms of intermolecular interactions of water and solute. The high frequency

process reflecting to depolarization comes from diffuse rotation of molecules in making/breaking process of molecular cluster.

- **International/National status**: The following scientists are actively doing research in this field at international/National level:

1. N Shiyanshiki, University of Tokyo, Japan.
2. S Yaghara, University of Tokyo, Japan
3. S Sudo, dept. of Physics, Tokyo city University, Tamazustumi, Setagaya, Tokyo,
4. A Catldo, university di Lecce, via Monteroni, 73100 Lecce, Italy
5. Undre Department of Physics, Dr. BAMU, Aurangabad (MS).
6. R.J. Sengwa, Jodhpur, JNV University, Jodhpur (RS)

- **Significance of the study:**

The dielectric relaxation measurements of organic liquids using a TDR make an immense impact on the fundamental study. The present study is devoted to dielectric relaxation of Haloalkanes using TDR technique from 10MHz to 50GHz from dielectric relaxation parameters; one can understand Molecular association,

orientation and hydrogen bonding interaction of Haloalkanes molecules through solute-solvent interactions.

6. **Proposed work plan/Formulation and structure of study:**

First Year:

(i) Literature survey related to the Thesis topic

(ii) Course Work as per university syllabus

(iii) Literature Review of system to be studied.

Second Year:

(i)Measurement and Training for Dielectric spectroscopic technique and analysis of dielectric data

(ii) Extract the dielectric parameters.

Third year:

(i) Experimental data will be analysed

(ii) Present data in International/National Conferences and published in different International/National Journals

(iii)Publish experimental data in the peer Reviewed Journals

(iv)Writing Thesis and submit to University.

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